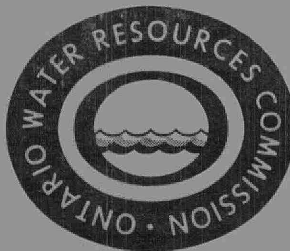
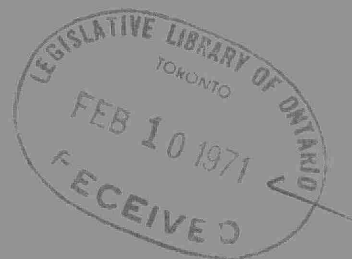


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O.W.R.C.
Water Quality
Survey

THE
ONTARIO WATER RESOURCES
COMMISSION



WATER QUALITY SURVEY

of the

BIG RIDEAU LAKE

1970

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THE
ONTARIO WATER RESOURCES
COMMISSION

Report on a
Water Quality Survey

of the
Big Rideau Lake

Division of Sanitary Engineering

District Engineers Branch

1970

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BIG RIDEAU LAKE
WATER QUALITY SURVEY

INTRODUCTION

A water quality study and a cottage waste disposal survey were performed at Big Rideau Lake during the summer of 1970. The combined resources of the Big Rideau Lake Association, the Leeds, Grenville and Lanark District Health Unit and the Ontario Water Resources Commission were utilized during the course of this survey. The Big Rideau Lake Association are to be commended for their interest in the preservation of Big Rideau Lake and for their active participation in this survey. The assistance of the staff of the above-mentioned health unit in the performance of the survey and the preparation of this report is also greatly acknowledged.



BIG RIDEAU LAKE AT NARROWS LOCK



BIG RIDEAU LAKE AT RIDEAU CAMPGROUND

SUMMARY AND CONCLUSIONS

As a result of the cottage and water quality survey performed at Big Rideau Lake during the summer of 1970, the following conclusions are drawn:

- 1) The number of summer cottages on this lake utilizing malfunctioning sewage disposal systems appears to be comparatively small. The problem systems encountered by the cottage study team are expected to be eliminated by the health authorities prior to the 1971 cottage season. Other problem areas will be dealt with as they become known to the health unit.
- 2) The sanitary quality of Big Rideau Lake was revealed to be quite acceptable for recreational purposes. Above average bacteria counts were encountered in the Bay at Portland at one of three sampling points. The reason for the high counts at this point has been attributed to discharges from pleasure boats. Since the

time of this survey the Province of Ontario has passed regulations which require the provision of pumpout facilities at all commercial marinas.

3) The chemical quality of the water in this lake was characteristic of many inland lakes. Nitrogen and phosphorus levels were generally normal with some higher levels evident in shallow bay areas. Biological activity is most evident in these sheltered bay and drowned land areas where nutrient build-up is contained. The elimination of man made nutrient inputs into the lake will help to control the rate of increase of biological activity; however, a continued natural aging process can be expected in Big Rideau Lake as normal nutrient inputs from land run-off and from recycled nutrients contribute to algae growth.

4) The increased use and popularity of the lake and environs will demand continued surveillance regarding land and water use by various government agencies.

RIDEAU RIVER WATERSHED

The Rideau River drains an area of approximately 1,296 square miles. A complex system of lakes known as the Rideau Lakes form the headwaters of this river system which flows north from Big Rideau Lake to the Ottawa River. Upper Rideau Lake is also connected to the watershed that flows to the St. Lawrence River by means of the canal locks at Newboro. The Rideau Canal was constructed early in the 19th Century to provide a water route from Kingston to Ottawa. In recent years this canal system has become a major tourist attraction to the area and caters to substantial boating traffic.

BIG RIDEAU LAKE

The Big Rideau Lake forms the heart of the Rideau waterway. The lake itself is quite large (Approximately 7 miles long and 4 miles wide at its widest point) and water depths in excess of 300 feet are **recorded** along the north side in the main channel.

Located in the Precambrian Shield the predominantly rocky and indented shoreline presents an aesthetic attraction for cottage development and weekend visitors. The main soil characteristics of the area around the lake are those of the Farmington series. These are thin soils of less than 12 inches of depth over limestone bedrock. The balance of the area is slightly stoney to rocky.

Boating, fishing and swimming are popular summer sports on Big Rideau Lake. Cottage development is particularly evident along the south and east shores of the lake. It has been estimated that there are some 576 cottage properties in the area.

The Police Village of Portland, located on the south shore of the lake in the Township of Bastard and South Burgess, is the main service area for the summer residents. The permanent population of this community is approximately 280. There are three marinas at Portland which serve the boating fraternity for the area.

IMPLEMENTATION OF THE SURVEY

The residents of the Big Rideau Lake area, both summer and permanent, expressed their concern to various governmental agencies that pollution of the lake was increasing and reaching

serious proportions. A formal request for a pollution survey of the lake during the summer of 1970 was extended by the Big Rideau Lake Association.

Under the able and energetic direction of the Association President, Mr. W. Parry, a meeting was held in Kingston with representatives of the Ontario Water Resources Commission and the Leeds, Grenville and Lanark District Health Unit. After a thorough discussion of the problems involved, it was agreed that as the two aforementioned agencies would not have staff available for a survey this year, the Association would employ two students and provide them with a boat.

The necessary technical assistance and supervision was to be assumed by the governmental agencies. The health unit was to direct the cottage sanitary survey, while the OWRC would perform water quality studies of the lake and prepare the report.

SANITARY SURVEY

PURPOSE AND SCOPE OF SURVEY

It was established by those organizing the survey that it would be carried out with two objectives in mind. These would be to:

1) Ascertain the present bacteriological quality of the lake and,

2) Determine what, if anything, was contributing to the pollution of the lake -

To accomplish this end, the team hired by the Association was provided with water sampling bottles (bacteriological and chemical), survey sheets and directions as to how to proceed with the survey.

The area was reported to contain approximately 576 cottage

properties, the Community of Portland having some 79 properties. The survey team was to attempt to complete as many inspections as possible in a six week working period. The health unit staff would carry out the survey in Portland. Correction measures, where required, would be undertaken by the health unit staff.

RESULTS OF SURVEY

The cottage survey team visited 271 premises and took 245 bacteriological water samples during the course of the survey. Four (4) premises were found to be polluting and seven (7) premises constituted a public health nuisance.

The four polluting were discharging directly to the lake, either septic or sink wastes. The seven others were deemed public health nuisances defined as a condition (not known to be contributing to pollution of the lake water) which is or may become injurious or dangerous to health or that prevents or hinders or may prevent or hinder in any manner the suppression of disease.

The premises surveyed indicated the individuals preference for modern conveniences. Of the 271 premises visited, 216 had flush systems, 44 had privies and 8 utilized other methods of sewage disposal (i.e. electric or chemical methods of sewage disposal). The problems associated with the disposal of wastes from flush systems was obvious during the survey. Of the 21 premises reported as being non-conforming, 10 were found to be due to malfunctioning septic tanks or marginal systems for the disposal of waste water. The balance were due to varying causes, from poorly located refuse dumps, poor types and locations of privies to cattle grazing too close to the water's edge.

CORRECTION

The systems mentioned above have been investigated and corrective action has been instituted in most cases. The health unit indicated that all corrections will be completed by the start of the 1971 cottage season (May, 1971).

SAMPLING PROCEDURES

LAKE SAMPLES

Samples were collected from the lake for bacteriological examinations and/or chemical analyses at 15 predetermined locations by the OWRC. The sampling was performed at various times during the week, including a weekend in order that representative water quality data could be obtained. A list of the sampling locations is included as Appendix I to this report. In addition to samples collected by OWRC staff a number of lake samples were also collected by the cottage survey team. Summaries of the sample results are included as follows:

Appendix II Bacteriological Results (Lake)

Appendix IIA Summary of Bacteriological Samples
Collected by Cottage Survey Team.

Appendix III Chemical Results (Lake)

Appendix IIIA Chemical Results of Samples Collected
by Cottage Survey Team.

A map has been appended which illustrates the locations of the OWRC sampling points.

DRINKING WATER SAMPLES

The cottage survey team collected samples for bacteriological examinations from some 187 private water supplies. Both groundwater (well supplies) and surface water were used for

drinking water supplies. The samples were submitted to the Department of Health Laboratory in Kingston for examination. A summary of the sample results is included in Appendix IIA.

SAMPLE RESULTS

LAKE SAMPLES (Bacteriological Quality)

The OWRC microbiological criteria for surface waters used for total body contact recreational purposes, recommend the following upper limits, when ingestion of the water is probable:

Coliforms - 1000 organisms per 100 ml. of sample

Faecal Coliforms - 100 organisms per 100 ml. of sample

Enterococcus - 20 organisms per 100 ml. of sample
(Faecal Streptococci)

The criteria are based on the geometric mean density of organisms in a series of at least 10 samples per month, including samples collected during weekend periods.

The appended sample results (samples collected by OWRC) reveal that the geometric mean coliform density was 85, which is well within the objectives. The coliform objective was only exceeded in one sample of the 45 samples collected at 15 different sampling points. The faecal coliform objective was met in all samples, while the enterococcus objective was exceeded in two samples. The point at which the criteria were exceeded was at the west end of the bay at Portland (Len's Cove). The above average counts obtained at this point were encountered in samples collected on a Sunday and a Monday which would correspond to the above normal weekend boating traffic. Only seven (7) samples out of 265 samples, collected by the cottage survey team adjacent to investigated properties, exhibited high coliform counts.



BAY AT PORTLAND (LEN'S COVE)

LAKE SAMPLES (Chemical Quality)

A number of chemical quality parameters were examined during this survey. Some of these parameters, particularly nitrogen and phosphorus determinations, relate to biological processes in the lake. A discussion of several of the parameters studied is included in Appendix IV of this report.

It is observed that the nitrogen and phosphorus levels were generally within desirable ranges. A number of exceptions were noted in the samples collected by the cottage survey team. Some of the digressions in these results have been attributed to the sampling locations which tended to be closer to shore and in shallower water than were the OWRC sampling points.

Total Organic Carbon (TOC) is a measure of the total carbonaceous material available for uptake by micro-organisms.

Examinations for TOC during this study produced results within tolerable ranges.

The OWRC objectives for chloride has been set at an upper limit of 250 parts per million (ppm). Abnormal amounts of chloride in a natural water suggests pollution probably of a chemical origin. Chloride levels in Big Rideau Lake were quite low.

Recreational waters should be free of materials which will cause the pH to change beyond the range of 6.5 to 8.3. The average pH in 32 samples was 8.5. While this pH level presents no particular hazard to water quality, it is worthy of consideration in future surveys.

Conductivity is a means of measuring the total dissolved solids content of the water. High dissolved solids concentrations are associated with corresponding high levels of sulphates and/or chlorides. An upper limit of 500 ppm has been adopted for this parameter. Total dissolved solids levels in Big Rideau Lake were well within this limit.

The dissolved oxygen determinations were performed at approximately three feet below the surface during a variety of weather conditions. The average dissolved oxygen level was 9.10 ppm. A minimum dissolved oxygen level of 6.0 ppm is frequently suggested in order to support fish life and associated biota. Water temperatures also recorded at the three foot level were also within the OWRC objective of 85° F (or 29°C).

Based on the above parameters the chemical quality of Big Rideau Lake was generally acceptable and did not indicate general enrichment of the waters. Nutrient levels were obviously higher in several of shallower, sheltered bay areas.

The geography of Big Rideau Lake, like many inland lakes, is such that the loss of nutrients through overflowing streams is relatively small. The nutrients are recycled and become available at increasing amounts for future development of algae and aquatic plants. All lakes are subject to inputs of dissolved mineral substances and sedimentation which increase their fertility as part of a natural aging process. Nutrient inputs from domestic wastes, agricultural run-off and seepage from summer residences can aggravate an already fertile system. Therefore, control of the rate of this aging process will depend, in part, on the success in controlling man made nutrient inputs.

The OWRC has been conducting an intensive Eutrophication Study of the Muskoka Lakes for several years. An important part of this study is the assessment of the degree of translocation of artificial nutrients from septic tank systems to the lakes in a variety of soil conditions. The Department of Health is also studying various aspects of septic tank operations including the success of "elevated" tile bed systems. It is anticipated that studies such as those mentioned above will lead to a better understanding of subsurface disposal systems and where applicable, improvements to the methods of private waste disposal employed in recreational lake areas.

DRINKING WATER SUPPLIES

Some 187 samples of ground and surface water supplies were collected. A review of the laboratory results indicated that 134 or 72 percent of the supplies were Grade I. Of the remaining 53 supplies 19 were Grade II and 34 were Grade III. There was no differentiation of sources of supply, consequently the number of

surface water supplies which were being utilized without the benefit of treatment could not be determined. The OWRC recommends that all surface waters used for domestic purposes should be provided a minimum of chlorination treatment.

WCS/jmc


.....
W.C. Stevens, Technician,
Division of Sanitary Engineering.

APPENDIX I
BIG RIDEAU LAKE SURVEY
SAMPLING LOCATIONS

<u>NO.</u>	<u>DESCRIPTION</u>
BR-1	Murphy Bay - Approx. centre of bay
BR-2	Hudson Bay - Opposite marina on south shore
BR-3	Narrows Locks - Boat channel
BR-4	North Shore - Opposite Rideau Campground
BR-5	Horseshoe Bay - Approx. centre of bay
BR-6	Rocky Narrows - Just east of Pine Point
BR-7	Between Tar Island and Houghton Bay
BR-8	Opposite Government Wharf at Cedars Point
BR-9	Briton Bay - Upper end
BR-10	Briton Bay - Lower end
BR-11	Opposite south end of MacDonalds Island
BR-12	Mid Bay opposite Portland
BR-13	Portland - West end of bay
BR-14	Portland - Centre of bay opposite Portland Marina
BR-15	Portland - East side opposite Mill Bay

APPENDIX II
BIG RIDEAU LAKE
WATER QUALITY SURVEY
BACTERIOLOGICAL RESULTS

<u>SAMPLING POINT</u>	<u>DATE</u>	<u>COLIFORMS</u> <u>/100 ML</u>	<u>FAECAL COLIFORMS</u> <u>/100 ML</u>	<u>FAECAL STREPTOCOCCI</u> <u>/100 ML</u>
BR-1	12-7-70	210	10	4
	14-7-70	230	1	10
	20-7-70	30	4	< 2
BR-2	12-7-70	270	< 2	4
	14-7-70	580	< 2	4
	20-7-70	34	< 2	< 2
BR-3	12-7-70	26	4	8
	14-7-70	90	< 2	6
	20-7-70	110	2	2
BR-4	12-7-70	28	< 2	< 2
	14-7-70	850	< 2	1
	20-7-70	110	< 2	2
BR-5	12-7-70	78	2	8
	14-7-70	200	< 2	7
	20-7-70	24	< 2	< 2
BR-6	12-7-70	92	< 2	3
	14-7-70	130	< 2	4
	20-7-70	6	< 2	< 2
BR-7	12-7-70	92	< 2	4
	14-7-70	83	< 2	5
	20-7-70	30	< 2	< 2
BR-8	12-7-70	50	< 2	< 2
	14-7-70	190	< 2	1
	20-7-70	24	< 2	2
BR-9	12-7-70	20	< 2	< 2
	14-7-70	30	< 2	1
	20-7-70	20	< 2	< 2
BR-10	12-7-70	30	< 2	< 2
	14-7-70	190	< 2	3
BR-11	12-7-70	44	2	8
	14-7-70	86	< 2	7
BR-12	12-7-70	64	< 2	< 2
	14-7-70	49	1	1
	20-7-70	22	2	0

<u>SAMPLING POINT</u>	<u>DATE</u>	<u>COLIFORMS /100 ML.</u>	<u>FAECAL COLIFORMS /100 ML</u>	<u>FAECAL STREPTOCOCCI /100 ML</u>
BR-13	12-7-70	1600	100	98
	14-7-70	190	10	10
	20-7-70	970	18	32
BR-14	12-7-70	210	10	8
	14-7-70	130	1	3
	20-7-70	270	4	4
BR-15	12-7-70	70	22	16
	14-7-70	60	3	11
	20-7-70	68	2	6
GEOMETRIC MEAN DENSITY		85	-	-
OWRC OBJECTIVES (Recreational Waters)		1000	100	20

APPENDIX IIA

SUMMARY

BACTERIOLOGICAL SAMPLES COLLECTED BY COTTAGE SURVEY TEAM

Lake Samples - 258 samples exhibited low counts

- 7 samples exhibited high counts

Total - 265

Drinking Water Samples

Grade 1 - 134 supplies (Total coliform organisms absent
(Faecal coliform organisms absent

Grade 2 - 19 supplies (Total coliform organisms present
(Faecal coliform organisms absent

Grade 3 - 34 supplies (Total coliform organisms present
(Faecal coliform organisms present

Total - 187

APPENDIX III

BIG RIDEAU LAKE - WATER QUALITY SURVEY

CHEMICAL ANALYSES

SAMPLING POINT	DATE (1970)	N I T R O G E N A S N				P H O S P H O R U S A S P		T.O.C.	CHLORIDE AS CL	pH at LAB.	COND. UMHO	DISS. OXYGEN	TEMP. ° C
		FREE AMMONIA	TOTAL KJELDAHL	NITRITE	NITRATE	TOTAL	SOLUABLE						
BR-1	12-7	.06	.37	.010	<.01	.020	.002	7	5	8.5	221		
	14-7	.07	.40	.008	.02	.014	.002	9	5	8.6	219	8.65	21.0
BR-2	12-7	.23	.47	.011	<.01	.004	.001	7	4	8.5	220		
	14-7	.06	.39	.006	<.01	.020	.002	9	4	8.6	217	8.70	21.2
BR-3	12-7	.53	.60	.013	<.01	.040	.040	7	6	8.3	223		
	14-7	.04	.43	.006	<.01	.030	.003	7.5	6	8.5	223	7.80	21.8
BR-4	14-7	.05	.39	.007	.01	.014	.002	7	5	8.6	219	9.00	21.0
BR-5	14-7	.06	.40	.007	<.01	.020	.001	7.5	4	8.6	219	8.70	21.1
BR-6	12-7	.05	.34	.010	.01	.014	.002	5.5	5	8.6	221	9.10	22.8
	14-7	.05	.39	.006	<.01	.019	.001	7.5	4	8.6	221	9.00	21.2
BR-7	12-7	.02	.36	.010	.01	.018	.002	6.5	5	8.6	222	8.95	22.5
	14-7	.04	.43	.006	<.01	.022	.001	7.5	4	8.7	221	9.10	21.5
BR-8	12-7	.02	.34	.012	<.01	.012	.002	5.5	4	8.6	222	9.30	22.5
	14-7	.04	0.46	.007	<.01	.019	.001	7	4	8.7	220	8.80	21.5
BR-9	12-7	.01	.40	.012	<.01	.052	.002	5.5	4	8.3	221	8.40	23.5
	14-7	.08	.45	.007	<.01	.018	.001	6.5	4	8.5	222	8.12	21.5
BR-10	12-7	.01	.38	.013	<.01	.022	.002	5	5	8.6	219	9.20	22.5
	14-7	.04	.43	.006	<.01	.018	.001	7	6	8.7	219	8.70	21.7
BR-11	12-7	.03	.33	.011	<.01	.11	.002	6	4	8.6	217	9.60	22.5
	14-7	.04	.44	.007	<.01	.018	.003	7.5	4	8.6	217	8.20	22.0

APPENDIX IIIA

BIG RIDEAU LAKE - WATER QUALITY SURVEY

CHEMICAL SAMPLES COLLECTED BY COTTAGE SURVEY TEAM

<u>LOCATION</u>	<u>DATE</u>	<u>N I T R O G E N A S N</u>				<u>PHOSPHORUS AS P</u>		<u>T.O.C.</u>	<u>CHLORIDE AS CL</u>	<u>pH AT LAB.</u>
		<u>FREE AMMONIA</u>	<u>TOTAL KJELDAHL</u>	<u>NITRITE</u>	<u>NITRATE</u>	<u>TOTAL</u>	<u>SOLUBLE</u>			
100' offshore at mill dump	16-7-70	.05	0.52	.032	<.01	0.039	.008	9.5	-	-
Macdonald Is. 30' offshore										
Big Rideau Lake	18-7-70	.07	.50	.008	<.01	.018	.006	9	-	-
Gauett's Bay	22-7-70	.06	.48	.007	<.01	.015	.004	8.5	-	-
Minnow Bay	22-7-70	.04	.50	.001	<.01	.012	.003	8.5	-	-
Minnow Bay	24-7-70	.07	.65	.001	<.01	.016	.004	7	-	-
Minnow Bay	24-7-70	.02	.45	.001	<.01	.014	.002	8	-	-
Minnow Bay	26-7-70	.06	.54	.001	<.01	.013	.004	8.5	-	-
McEwen's Bay	26-7-70	.02	.42	.001	<.01	.013	.002	8.5	-	-
Stumps in Bay	26-7-70	.06	.58	.001	<.01	.018	.003	8	-	-
Small Bay adjacent	"									
Mr. Clive McKenny -										
clear to weedy.		.04	.48	.001	<.01	.030	.005	8	-	-
Briton Bay, Heavy water	"									
weeds and Stumps.		.07	.55	.002	<.01	.014	.006	9		
Briton Bay, Heavy water	"									
weeds and Stumps.		.08	1.1	.001	<.01	.052	.010	10.5	-	-
Public Camp Bay	28-7-70	.26	.65	.004	<.01	.016	.010	7.5	4	8.2
Rideau Lake	28-7-70	.09	.54	.003	<.01	.015	.010	7.5	4	8.3
Morton Bay	28-7-70	.20	.40	.004	<.01	.012	.008	6	5	8.2
Sheldons Bay	1-8-70	.12	.50	.002	<.01	.015	.008	6	5	8.6
Murphy's Bay	1-8-70	.08	.45	.002	<.01	.013	.006	8.5	4	8.6
Rideau Lake	2-8-70	.16	.44	.002	<.01	.011	.010	6	4	8.5
Bass Bay	4-8-70	.10	.40	.002	<.01	.007	.002	6	4	8.5
Hawes Bay	4-8-70	.08	.44	.002	<.01	.012	.006	6	5	8.7

SAMPLING POINT	DATE (1970)	N I T R O G E N A S N				P H O S P H O R U S A S P			C H L O R I D E A S C L	p H a t . L A B .	C O N D . U M H O	D I S S . O X Y G E N	T E M P . ° C
		F R E E A M M O N I A	T O T A L K J E L D A H L	N I T R I T E	N I T R A T E	T O T A L	S O L U A B L E	T . O . C .					
BR-12	12-7	.02	.36	.010	.01	.012	.002	7.5	4	8.6	219	9.20	22.0
	14-7	.05	.41	.008	<.01	.021	.001	7	4	8.6	217	8.50	21.8
BR-14	12-7	.04	.36	.010	.01	.024	.002	6.5	4	8.6	214	9.60	22.5
	14-7	.02	.43	.007	<.01	.020	.002	7	5	8.6	216	8.90	21.8

APPENDIX IV

SIGNIFICANCE OF NITROGEN AND PHOSPHORUS ANALYSES

NITROGEN

Ammonia Nitrogen (Free Ammonia) is the soluble product in the decomposition of nitrogenous organic matter, it is also formed when nitrates and nitrites are reduced to ammonia either biologically or chemically. Some small amount of ammonia, too, may be swept out of the atmosphere by rain water.

The following values may be of general significance in appraising free ammonia content: Low 0.015 to 0.03; Moderate 0.03 to 0.10 ppm; High 0.10 or greater.

Total Kjeldahl is a measure of the total nitrogenous matter present except that measured as nitrite and nitrate nitrogens. The Total Kjeldahl less the Ammonia gives a measure of the organic nitrogen present. Ammonia and organic nitrogen determinations are important in determining the availability of nitrogen for biological utilization. The normal range for Total Kjeldahl would be 0.1 to 0.5 ppm.

Nitrite Nitrogen

Nitrite is usually an intermediate oxidation product of ammonia. The significance of nitrites, therefore, varies with thier amount, source and relation to other constituents of the sample, notably the relative magnitude of ammonia and nitrate present. Since nitrite is rapidly and easily converted to nitrate, its presence in concentrations greater than a few thousandths of a part per million is generally indicative of active biological processes in water.

Nitrate Nitrogen

Nitrate is the end product of aerobic decomposition of

nitrogenous matter, and its presence carries this significance. Nitrate concentration is of particular interest in relation to the other forms of nitrogen that may be present in the sample. Nitrates occur in the crust of the earth in many places and are a source of its fertility.

The following ranges in concentration may be used as a guide. Low, has less than 0.1 ppm; Moderate, 0.1 to 1.0 ppm; High, greater than 1.0 ppm.

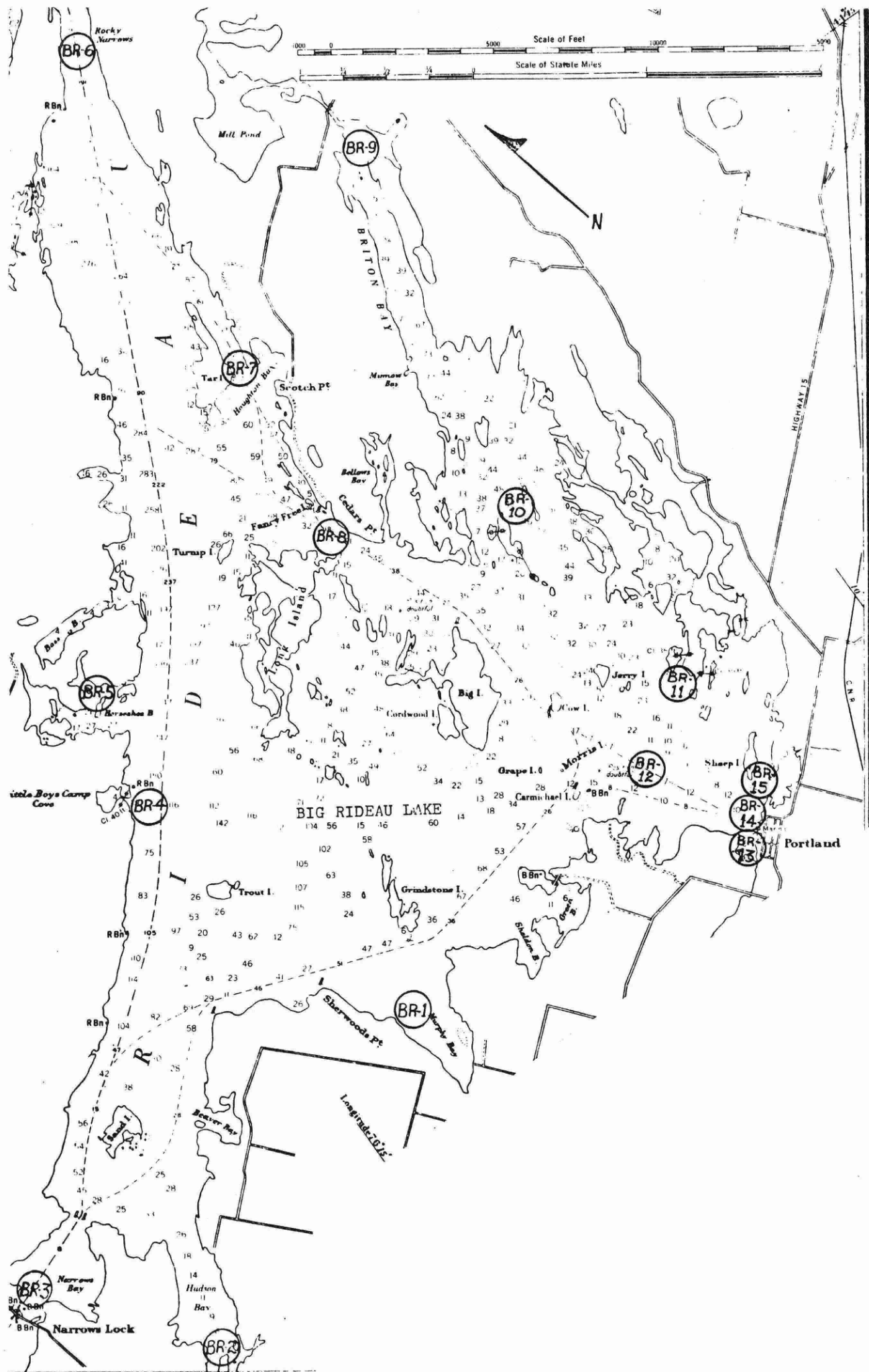
PHOSPHORUS

Total Phosphorus

Total Phosphorus is a measure of both the organic and inorganic forms of phosphorus present.

Soluble Phosphorus

Soluble Phosphorus is a measure of the orthophosphate only and when subtracted from the total phosphorus gives an indication of the concentration of organic phosphorus present. That is, the soluble phosphorus is a measure of the inorganic phosphorus present except the phosphorus in the form of polyphosphate, which however, in surface waters is usually insignificant. Inorganic phosphorus in concentration in excess of 0.01 ppm may cause nuisance conditions.





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